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The clinical course and management of thoracic empyema

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Summary

We report a prospective multi-centre study of the clinical course and hospital management of thoracic empyema in 119 patients (mean age 54.8). The commonest presenting symptom was malaise (75%), 55% were febrile; 31% were previously well with no predisposing condition. Initial treatments were antibiotics alone (5), needle aspirations (46), intercostal tube drainage (61), rib resection (3) and decortication (4). Overall, intercostal drainage was used in 77 patients (16 failed aspirations), surgical rib resection in 24 (1 failed aspirations, 20 failed drainage), and surgical decortication in 28 (6 failed aspirations, 17 failed drainage). Only 4 patients received intrapleural fibrinolytic agents. Aspiration and drainage were likely to fail if the empyema was >40% of the hemithorax. Median time from treatment start to discharge was: aspirations, 26 days; drainage, 23 days; resection 11 days; decortication, 12 days. Overall 21 patients died (12 with empyema as the major cause); two had been surgically treated. Mortality correlated with age, diabetes, heart failure, and low serum albumin at admission. Infecting organisms, identified in 109 patients (92%) included anaerobes (37), *Str. melleri* (36), and *Str. pneumoniae* (28). Six months after discharge, all but six survivors had regained their previous health.

Introduction

The true incidence of empyema is unknown. Most cases are admitted to hospital with the condition well established. It is unusual for empyema to develop as a complication of community-acquired pneumonia after the patient has been admitted to hospital. This occurred in 1.6% of cases in one large series.[1]

The presentation varies. Sometimes there are clear-cut respiratory symptoms, but often the clinical features are non-specific and of insidious onset. It may thus present to clinicians of any discipline. Once diagnosed, empyema can usually be successfully treated. It is thus important that all practising clinicians are alert to this diagnosis.

No clear management guidelines exist other than the widely held view of thoracic surgeons who stress the need for effective drainage of the pleural space.[2,3]

The British Thoracic Society Research Committee has conducted a prospective multicentre study to document the present day clinical course and management of empyema.

Definition

Empyema was defined as an opaque fluid in the pleural space with the cloudiness due to neutrophils and/or organisms. Tuberculous empyema was excluded, as was empyema complicating trauma or surgery, or surgical conditions such as ruptured oesophagus.

Methods

Physicians who were members of the British Thoracic Society and Thoracic Surgeons were asked to participate in the study. In all, 119 patients were entered by 59 individual physicians and surgeons from all over the UK between 1986 and 1990. Participants

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were from large Teaching Centres and smaller District General Hospitals and overall were felt by the Study Organizers to be representative of current UK practice. Participants were asked to register their patients with the Central Co-ordinator as soon as the diagnosis was made, and complete a standardized proforma giving a detailed history of the presenting illness including, where known, treatment, past medical history, tobacco and alcohol consumption. Wherever possible, the admission chest radiographs were assessed by the Central Co-ordinator and a single radiologist, both in terms of the presenting radiological features and the proportion of the hemithorax occupied by the empyema (approximated to the nearest 10%). Participating clinicians also supplied a sketch diagram of the admission radiograph so that in all cases a radiological estimate of the size of the empyema was available.

Blood, pleural fluid and where available sputum were cultured. Pneumococcal antigen was sought in pleural fluid, blood and urine. Consistency and odour of the pleural fluid were noted. A full blood count and routine biochemical profile were performed. At discharge from hospital, clinicians recorded their management of the empyema (simple aspiration, tube drainage or surgery) together with the patient's outcome. Subsequently, chest radiographs and clinical status were assessed at 6 months after discharge to document the degree of recovery.

Results

Patient characteristics

One hundred and nineteen patients (78 male) were entered into the study. Their mean(SD) age was 54.8(20.4) years, range 7 months–85 years. Although all social classes were represented, the proportion of patients in Classes 4 and 5 was twice that expected. Forty-two patients had never smoked and 31 were ex-smokers. Only 9 patients admitted to drinking more than 30 units of alcohol a week and 46 claimed to be teetotal.

Fifty-seven had one or more associated conditions which may have predisposed to the development of empyema either by encouraging aspiration of oral secretions (35 patients) or by reducing host resistance to infection. Forty-nine (41%) patients gave a history of chronic chest disease. In all, 85 (71%) patients had either or both a possible predisposing condition or chronic lung disease. Conversely, in the remaining 34 (29%) patients there was no relevant past clinical history (Table 1).

The median haemoglobin on admission was 11 g/dl and white count 18.0×10^6 (85% neutrophils). Renal function was unremarkable (median urea 5.7) but hypoproteinaemia was common (total protein 66 and albumin 27.0 g/l).

Table 1 Frequency of associated factors which may predispose to empyema

Factor	*n*
Systemic factors ($n=57$)	
Poor dental hygiene	12
Cardiac failure	9
Diabetus mellitus	9
Mental retardation	8
Rheumatoid arthritis	7
Alcoholic binge	7
Sedative drugs	7
Corticosteroids or immunosuppressive drugs	7
Aspiration due to neurological disease	6
Gastro-oesophageal reflux	5
Gastrointestinal haemorrhage	3
Others—miscellaneous	21
Lung disease ($n=49$)	
COPD	33
Bronchial carcinoma	8
Previous TB	7
Bronchiectasis	5
Others—miscellaneous	13

Presenting features and radiology

The median interval from onset of any symptoms to the first general practitioner visit was 5 (interquartile range 1–13) days and between this visit and hospital admission 13 (4–31) days. Empyema was considered the most likely diagnosis by the admitting doctor in 35/119 (29%) patients. Other conditions entertained at admission were 'pleural effusion' (30), consolidation or pneumonia (30), neoplasm (8), COPD (4), septicaemia (2), cardiac failure (2) and in eight others, miscellaneous diagnoses. The definitive diagnosis (which depends upon the demonstration of purulent fluid in the pleural space) was made in 73/119 (61%) patients within 48 h of admission but in 28 patients the diagnosis was delayed for more than one week and in five patients, this delay exceeded one month.

The principal symptoms recorded at the initial presentation to the general practitioner and on admission to hospital are shown in Figure 1. On admission, the most frequent symptom was malaise (73%) and only 56% of patients were reported as being pyrexial.

The original chest radiographs were available for assessment by the panel in 78 (66%) patients. Forty-eight of these (62%) were considered typical of fluid in the pleural space but in the remainder, some other diagnosis, for example pneumonia or tumour, could reasonably be made. The size of the empyema

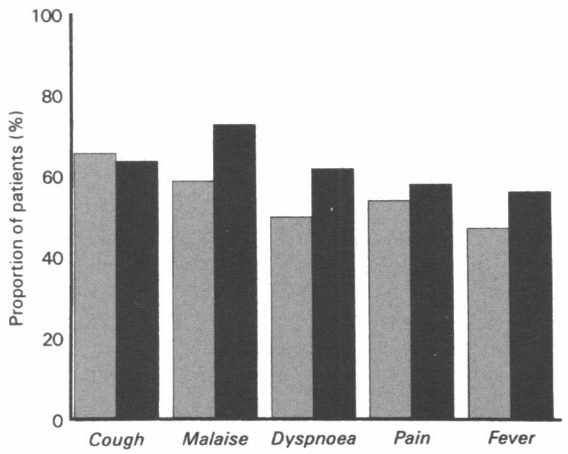

Figure 1. Principal symptoms on presentation to GP ▦ and on admission to hospital ■.

varied from 10% to a complete 'white out' of the hemithorax.

Microbiology

A positive diagnosis was made in 109 (92%) patients. The organisms found could be divided into six main types (Figure 2). Anaerobes or enterobacteriacea were often present in mixed cultures, whereas pneumococci, staphylococci and *Streptococcus milleri* were generally pure isolates. The 'other' group included two cases of *Haemophilus influenzae* and one of *Legionella*, diagnosed by serology. All three infants had staphylococci.

The pneumococci were identified in 28 (24%) patients by one or more means (blood culture, culture of pleural fluid or positive pneumococcal antigen). Sputum was cultured in 105 patients. Various non-specific organisms were grown. In only three sputum specimens did the organism identified coincide with the infecting organism of the empyema.

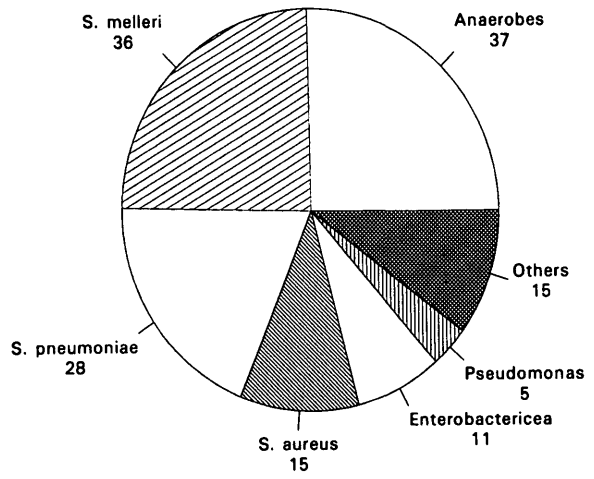

Figure 2. Spectrum of organisms identified in this series (see text).

Empyema fluid was described as malodorous in 74 (62%) of patients. Anaerobes were cultured from half of these. By contrast, only one pneumococcal empyema was considered malodorous. Pleural fluid was described as 'thick' in 50 (42%) patients, but consistency did not correlate with any specific organism, nor was it a predictor of patients who ultimately required surgery.

Details of antibiotic therapy prior to admission were incomplete but 18 patients were known to have received no antibiotics. In those patients who received antibiotics and in whom organisms were subsequently identified the drug(s) used was appropriate in 43 and inappropriate in 16 patients. In five, no organism was identified.

Once the diagnosis was made, patients under the care of a physician invariably received antibiotics appropriate to the organism isolated. By contrast, only 27 (53%) patients treated surgically received any antibiotics postoperatively.

Drainage of the pleural collection

The majority of patients (112) were admitted under the care of a physician. Five patients were treated by diagnostic aspiration and antibiotics only: three survived and two died (one from empyema). A further 46 were initially treated by repeated aspirations and antibiotics: 19 required no further treatment and four died (three from empyema) but 23 required further treatment. Seventy-seven patients were treated by intercostal tube drainage, 61 as the initial treatment and 16 following a failure of repeated aspirations. Twenty-seven of these patients required no further treatment, 13 died (7 from empyema) but 37 required further intervention. Three patients were initially treated by rib resection, and a further 21 patients came to rib resection after failure of either repeated aspirations or intercostal tube drainage. Two of these patients died (one from empyema). Only two patients required further surgical intervention by decortication. In all, 28 patients were treated by decortication and all survived. In four of these patients, it was the only treatment.

The overall median hospital stay was 23 days (interquartile range 15–42). When the initial treatment was aspiration, the median time to discharge was 23 days, and when tube drainage was the initial treatment, the median time to discharge was 26 days. In instances when either tube drainage or aspiration was successful and the only form of treatment, the median time to discharge was 21 days compared to 26 days when the treatment was unsuccessful. Following rib resection or decortication, patients were discharged after median periods of 11 and 12 days, respectively.

Bronchoscopy

Participants were asked whether their patients were bronchoscoped and if so, for what indication. Overall 49 (40%) patients were bronchoscoped, usually to exclude a tumour predisposing to empyema (43 patients). Tumour was however found in only five of these patients.

Mortality and morbidity

Twenty-one (18%) patients died, in 12 of whom empyema was considered the major cause of death. In six others, the empyema was associated with a carcinoma of the bronchus. Two patients died of a myocardial infarction and in one death was attributed to senility. The mean age of those who died from empyema was 73 years, compared to 51 years in survivors ($p<0.001$). Mortality was significantly higher in those with heart failure ($p=0.002$) or diabetes ($p=0.006$). Factors such as the use of antibiotics before admission, the nature of the organisms identified or the length of time between first symptoms and ultimate diagnosis did not correlate with prognosis, but the mean serum albumin on admission was considerably lower in those who died when compared to survivors (21.1 vs. 28.7 g/l, $p<0.001$).

Six months after discharge, all but seven surviving patients had regained their usual performance status. X-rays in 9 patients showed appreciable pleural thickening. These included four with an indwelling intercostal drain. In the rest, minimal changes only persisted.

Discussion

This study is a prospective audit of the diagnosis and treatment of empyema in a representative sample of hospitals in the UK. There is frequently delay in general practice in referring patients and in making the diagnosis. This is not surprising, as the condition presents very rarely to individual general practitioners. Moreover, the presenting features, rather than suggesting respiratory disease, are often non-specific, so that other diagnoses, for example, malignant disease are frequently entertained. Our findings emphasize the need for an early X-ray examination in patients with a vague history of malaise, fever, weight loss, etc., particularly after a respiratory infection or when there are localizing physical signs in the chest. The longer the diagnosis is delayed, the more pronounced the symptoms become.

Further delay in diagnosis occurred in hospital, even with the benefit of investigations. Thus, the admitting medical officers considered empyema the most likely diagnosis in less than a third of the patients and in nearly a quarter, the diagnosis had still not been made after a week in hospital, whilst in some, this delay exceeded a month.

Our study identifies a number of causes for this delay. In 25 patients, pleural fluid was suspected soon after admission, but the pleural tap was dry or yielded clear fluid only. In 37 (31%) a tumour or pneumonia was suspected from the X-ray appearances rather than a pleural collection. The Co-ordinator and a radiologist confirmed that a significant proportion of the admission radiographs could be misleading, particularly when no lateral film was available. Although not formally examined in this study, it is likely that the regular use of lateral films and more general use of ultrasound (both to confirm and localize pleural fluid as a guide to the initial tap) would overcome much of this delay.

Helpful laboratory findings pointing to the diagnosis are a raised white count, a non-specific anaemia and a reduced serum albumin. This pattern of laboratory abnormalities in association with an abnormal X-ray should always raise the possibility of empyema.

This survey demonstrates that most cases of empyema still occur in those patients in whom it has been traditionally described: for example, children with staphylococcal pneumonia, adults with pneumococcal pneumonia, alcoholics, epileptics and other conditions that predispose to aspiration.[4] We confirm rheumatoid arthritis as a further category of susceptible patients.[5,6] However, it is important to appreciate that up to a third of empyemas can occur in patients with no apparent predisposing cause. Interestingly, bronchial carcinoma was identified in only five patients in this series, following bronchoscopy in 43 patients. This suggests that relatively few empyemas occur as a complication of bronchial carcinoma and questions the perhaps traditional view that all patients with chronic chest sepsis should be bronchoscoped.

This is the first study to look prospectively at the treatment and outcome of empyema. Previous reports have been either retrospective, or more commonly have concentrated on those patients requiring surgical management.[3,7,8] By the nature of our study design, we cannot give an overall incidence of empyema, or a complete breakdown of treatment modalities. However our participating clinicians included general physicians, chest physicians and thoracic surgeons. The study should therefore give a representative picture of current management.

Medical treatment included the use of antibiotics alone after diagnostic aspiration, repeated aspiration of the pleural space or the insertion of an indwelling drainage tube. Surgical treatment was either rib resection with mechanical breakdown of locules and tube drainage or decortication. The great majority of the patients were initially admitted under a physician; in only seven was surgery the initial method of

treatment. Medical treatment was successful in 47 patients. In 41 others, surgical treatment was required in addition (Figure 3). Included in this latter group were a number of patients with a particularly protracted hospital stay. We therefore examined a number of variables, some based on previous reports to see if we could identify the patients most likely to require surgery. These included previous use of antibiotics,[9] the length of time before diagnosis,[9] consistency of the pus,[10] the type of organisms and the estimated size of the empyema. Of these, only the latter was helpful. Thus medical treatment was successful in only 24% of patients whose empyema occupied more than 40% of a hemithorax whereas, when the empyema was smaller (20% or less), 81% were successfully managed medically. In empyemas of intermediate size (20–40%) the success rate was approximately 50% (Figure 3). The inference is that larger empyemas are more likely to be multiloculated collections and therefore less amenable to medical drainage.

The introduction of thoracoscopy, with its ability to break down adhesions, may well offer an effective alternative 'surgical' treatment in these patients. More recently fibrinolytic agents have been introduced into multiloculated empyemas with good effect and this technique too may obviate the need for surgery in some patients.[11] Experience with this treatment is however limited, and its precise role remains to be established, perhaps by randomized trial. In this series, four patients received such treatment, but this small number does not allow conclusions to be drawn.

Our results suggest a more favourable outcome in patients managed surgically (two deaths) than in those managed medically (nineteen deaths). Although this may be true, we cannot be sure that mortality in the medically treated group would have been lower had more patients been referred to a surgeon earlier, as many of the patients who died were old and with co-existent disease. Indeed, we did not specifically enquire whether a surgical opinion was sought in these patients, many of whom may have been unfit for anaesthesia and surgery.

Antibiotics have revolutionized the treatment of pneumonia and thus reduced the incidence of empyema. Their role, however, in the treatment of established empyema is unclear. They clearly play an important role in the control of associated septicaemia (eight patients had positive blood cultures on admission). We demonstrated organisms in the empyema of individuals who had had appropriate antibiotics before admission, supporting the surgical view that the only effective treatment of empyema is adequate drainage and obliteration of the pleural space. After surgical drainage, in our series, more than half of the patients received no antibiotics.

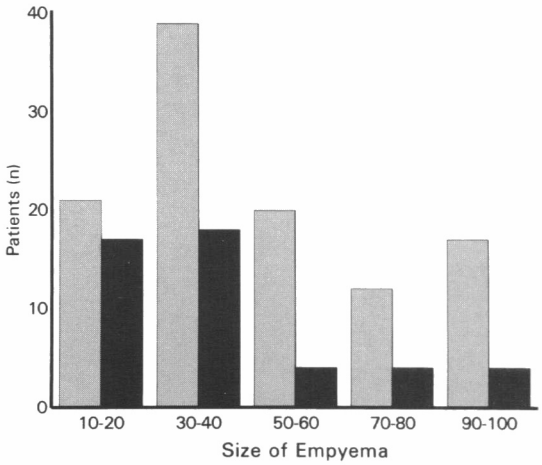

Figure 3. Frequency with which empyemas of various sizes (assessed as a percentage of the hemithorax involved) presented to physicians (▨) together with the number of patients for each size who were successfully treated 'medically' (antibiotics alone, aspiration or tube drainage) (■).

Empyema is a disease with a considerable mortality, especially in the elderly and those with heart failure or diabetes. In the survivors, however, recovery as judged both by chest X-ray and functional status was excellent. Only four of the surviving patients were left with chronic chest sepsis with some form of permanent pleural drainage. In all but five of the remainder, the X-ray had largely cleared by 6 months. Wherever possible, aggressive treatment is therefore worthwhile.

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